

# Studies on the behavior of some cultivars of *Dahlia* in the Botanical Garden Cluj-Napoca

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## ABSTRACT

Dahlias are particularly appreciated due to the elegance of the inflorescences and the long duration of flowering, which gives them multiple uses both in floral art and in landscaping. The research investigates 8 cultivars from the *Dahlia* genus concerning main morpho-ornamental characteristics (height of plants, length of floral stem, number of branches/plants, number of inflorescences per plant, diameter of inflorescence, number of ligules per inflorescence). Moreover were evaluated the determination of the amount of chlorophyll in the leaves and soluble dry matter content in tuberous roots. Based on the data obtained, we noticed a different suitability of these *Dahlia* cultivars, general having a positive significance concerning the morpho-decorative characteristics studied. The cultivars 'Record', 'Tsuki Yori No', 'Josephine' and 'Colour Spectable' present the highest amount of soluble dry matter in the tuberous roots, over 20%, and the chlorophyll content was over 500  $\mu\text{mol}/\text{m}^2$  to the cultivars 'Tsuki Yori No' and 'Colour Spectable'.

**Keywords:** perennial plant, morpho-decorative characteristics, tuberous root, chlorophyll, soluble dry substance.

## INTRODUCTION

The genus *Dahlia* contains approximately 30 perennial herbaceous species with tuberous roots, belonging to the family *Asteraceae* (*Compositae*) that is widely used for ornamental purposes as a potted plant or cut flower (Lord, 2003). It is native to Mexico, where, in addition to its ornamental value, it is a source of food and medicines.

Purple dahlia flowers and roots have potential for use in human food and can be considered good options to improve and diversify a healthy diet (Costa *et al.*, 2022). Its tuberous roots and petals are consumed and used in different gastronomic elaborations (Lara-Cortés *et al.*, 2014) and for medicinal purposes. Dahlia tuberous roots have a high content of carbohydrates, including inulin and fiber, proteins, vitamins, minerals, and bioactive compounds that can benefit human health (Lara-Cortés *et al.*, 2014; Ciobanu *et al.*, 2016). Mejía-Muñoz *et al.* (2020) indicated its tuberous root for diabetic patients because it helps to regulate blood glucose levels, in addition to decreasing cholesterol and triglycerides. Fălticeanu and Munteanu (2006) mention that the *Dahlia* root is rich in

starch-inulin, which can be converted into fructose, a sweetening substance, useful in the diet of diabetics.

This cut flower has very particular ornamental characteristics, so that it has become one of the most beautiful flowers in the world; in addition, it has the largest number of cultivars of any plant species and more than 50,000 have been registered with the Royal Horticultural Society of England (Bye and Linares, 2008; Țurlea (Ciobanu), 2023; Sho Ohno *et al.*, 2011).

In Romania, the production levels of cut flowers still remain very low, the supply does not correspond to the demand although the climatic conditions allow obtaining flowers in the field in the summer with low production costs; however, those possibilities are not sufficiently exploited. In recent years, in our country, *Dahlia* has gained a very significant share in the assortment of summer-autumn cut flowers (Toma and Petra, 2020). The special floricultural qualities of the species of the genus *Dahlia* make these plants suitable for cultivation in gardens and green spaces. They are easy to grow, the decoration period is quite long, and the flowers are numerous and with an impressive colour (Ciobanu (Țurlea) *et al.*, 2021).

This summer-2004, on the occasion of the Olympic Games in Paris, the dahlia decorated the parks and gardens of Paris and even around the Olympic sites. With its vibrant orange-red hue, a hybrid created in the Park Floral de Paris by a city gardener evoked the Olympic flame. This 'Olympic Dahlia' will be produced and planted every year, carving out a wonderful place for itself in the legacy of Paris 2024 (<https://www.paris.fr/en/pages/50-000-new-dahlias-created-for-the-paris-2024-games-27930>).

Dahlias can contribute not only to the decor but also to the flavor of culinary dishes, by adding nutritional value to the human diet. In Brazil, dahlia ligules are used only for ornamental purposes, where there is a wide diversity of types and colors (Costa *et al.*, 2022). Ligules have a long history as edible plant by the indigenous population in the form of small cakes, and even today this species is consumed in salads, in desserts, and as a garnish in many dishes by adding nutritional value to the human diet (Treviño *et al.*, 2007 cite by Costa *et al.*, 2022).

Mlcek and Rop, (2011) reported that while the petals are edible, the other parts of the plant may have an unpleasant taste and can cause allergic reactions.

Dahlias that are suitable for use as cut flowers must possess certain characteristics: vigorous, branching, produce many harvestable stems, good stem length, transport resistance, cut at an image stage, have the ability to grow on. Some of the favorite dahlias as cut flowers are 'Cafe au Lait', 'Hollyhill Black Beauty', 'Crazy for Don' and 'Brookside Snowball' (<https://www.dahlia.org/growing/the-dahlia-as-a-cut-flower/>).

The evolution of dahlia flowers has not ended, botanists and horticulturists who are passionate about these flowers are still trying to enrich this species and obtain blue dahlias (the only color missing from the color range of dahlias), resistant to frost, and also wants to obtain dahlias with a specific smell. The diversity of dahlia characteristics, in terms of plant height, flower shape and size, the multitude of colors, the number of branches on the plants, but also due to the beauty displayed, ranks it among the top flowers used in outdoor landscaping such as parks, gardens, borders etc. (Toma, 2009).

The large number of varieties within the *Dahlia* genus is the result of crosses of several species as: *D. variabilis*, *D. juarezii*, *D. imperialis*, *D. coccinea* and *D. rosea*. Most varieties are known in the crop resulted from the crossing of the species listed above and belong to the hybrid species *Dahlia hybrid* Hort. (Moldovan *et al.*, 2017).

Dahlia is a flowering plant highly appreciated around the globe since the first years of its discovery, this appreciation is growing more and more with the creation of new varieties.

The objective of this research was to investigate the behavior of some *Dahlia* cultivars in the conditions of Transylvania and to present their characteristics and qualities. The growth dynamics of dahlia plants varied according to the characteristics of the varieties.

## MATERIALS AND METHODS

The aim of this work was to present the characteristics and qualities as a cut flower of eight *Dahlia* cultivars grown in the Botanical Garden 'Alexandru Borza' of Cluj-Napoca: 'Record', 'Tsuki Yori No', 'Procyon', 'Veritable', 'Purple Gem', 'Colour Spectable', 'Princess' and 'Josephine' (Figure 1). The studies were carried out during the year 2023. The tuberous roots of the cultivars studied were planted in the experimental field on May 09, 2023, at a distance of 60 cm between plants and 30 cm between plants/row.

The environmental conditions in Cluj-Napoca are suitable for the cultivation of dahlias, a temperate climate, with an average annual temperature of around 9.2°C, with average precipitation of 500-600 ml/year. Air currents and winds ensure that the temperature drops during the night, conditions similar to those of the origin of dahlias, and the annual rest period is ensured by cold winters.

The experiment was placed randomly in three repetitions, from each cultivar 10 plants/repetition were planted, total 30 plants/variant. Morpho-decorative observations and measurements were made consisting of the height of plants, length of floral stem, diameter of inflorescence, number of inflorescences per plant, number of ligules per inflorescence, number of branches/plants.

Plant biometry measurements were carried out with: graduated ruler with markings in cm and inches or tape measure (for measuring plant height, flower stem height and plant diameter), and Stainless hardened electronic digital caliper for measuring inflorescence.

In autumn, when the tuberous roots were removed, the soluble dry matter was determined in the eight cultivars using the Zeiss handheld refractometer.

To determine the amount of chlorophyll in the leaf, a test was performed using the MC-100 Chlorophyll Concentration Meter, taking six leaves from each plant: two from the base of the plant, two from the middle and two from the top.



**Figure 1.** Biological materials of *Dahlia* cultivars

The obtained results were interpreted calculating the average of experience, and the differences between the variants were established by analysing the variance and using the analysis of variance, LSD test and Duncan test (Ardelean *et al.*, 2007).

## RESULTS AND DISCUSSIONS

### *The height of the plant*

Analyzing this character (Table 1), we notice two cultivars that stand out with a high waist, 'Colour Spectable' reaching 170.6 cm and 'Veritable' with 140.6 cm, and the lowest height was displayed by the 'Princess' cultivar with 55.2 cm.

**Table 1.** The height of the plant

No. var.	Cultivar	Average height (cm)	Relative value (%)	± d (cm)	Significance of differences
1	Record	75.8	72.8	-28.34	o
2	Tsuki Yori No	118.3	113.6	14.16	n.s.
3	Procyon	93.5	89,8	-10.64	n.s.
4	Veritable	140.6	135.0	36.46	***
5	Purple Gem	80.3	77.1	-23.84	o
6	Colour Spectable	170.6	163.8	66.46	***
7	Princess	55.2	53.0	-48.94	ooo
8	Josephine	98.8	94.9	-5.34	n.s.
Control	Average of the experience	104.14	100.00	-	-

$LSD5\% = 19.06$   $LSD1\% = 28.46$   $LSD0.1\% = 36.26$

The comparison between the average of the experience, considered as a control (104.14 cm) and the significance of the difference in the analyzed character, highlights very significant positive differences in the 'Colour Spectable' and 'Veritable' cultivars, very significant negative differences in the 'Princess' cultivar, significant negative differences in 'Record' and 'Purple Gem', and the cultivars 'Tsuki Yori No', 'Procyon' and 'Josephine' do not show significant differences from the average of the experience regarding plant height. The results of the analysis recommend placing tall cultivars in less visible green spaces, and short cultivars will be placed in front and in open places.

### *The number of branches /plant*

The ramifications of flowering plants are important both in terms of space occupied in exterior design and for the production of cut flowers. As a result of the data obtained in this research (Table 2), a strong character of branching is observed in the cultivar 'Tsuki Yori No', with an average of 15.33 branches, instead the fewest branches were observed in the cultivar 'Princess', with an average of 3.33 branches per plant.

The results of the analysis regarding the average number of branches per plant show us very significant positive differences in the cultivar 'TsukiYori No', distinctly significant positive differences in the 'Record' and 'Veritable', non-significant difference compared to the average of the experience that is the control, for the cultivar 'Procyon' and 'Josephine', and the negative differences of this character are observed in the other cultivars, namely, distinctly significant negative differences in the cultivars 'Purple Gem' and 'Colour Spectable', and 'Princess' shows very significant negative differences of this character

analyzed compared to the average of experience, considered as a control. We can say that from the point of view of the number of branches, the recommended cultivars are 'Tsuki Yori No', 'Record' and 'Veritable'.

**Table 2.** The number of branches /plant

No. var.	Cultivar	Average no. branches	Relative value (%)	± d (no.)	Significance of differences
1	Record	12.67	136.410	3.38	**
2	Tsuki Yori No	15.33	165.128	6.04	***
3	Procyon	9.00	96.923	-0.29	n.s.
4	Veritable	12.67	136.410	3.38	**
5	Purple Gem	6.00	64.615	-3.29	oo
6	Colour Spectable	6.00	64.615	-3.29	oo
7	Princess	3.33	35.897	-5.96	ooo
8	Josephine	9.30	100.107	0.01	n.s.
Control	Average of the experience	9.29	100.00	-	-

LSD5% = 2.25      LSD 1% = 3.16      LSD 0.1% = 4.46

### **The length of the floral stem**

The longest length of the flower stem is displayed by the cultivar 'Colour Spectable', with an average of 84.13 cm, followed by the cultivar 'Veritable', with 78.49 cm. The smallest flower stalk average was presented by the 'Princess', with 33.63 cm (Table 3).

**Table 3.** The length of the floral stem

No. var.	Cultivar	Average stem length (cm)	Relative value (%)	± d (cm)	Significance of differences
1	Record	42.45	69.84	-18.33	oo
2	Tsuki Yori No	66.62	109.61	5.84	n.s.
3	Procyon	64.08	105.43	3.30	n.s.
4	Veritable	78.49	129.14	17.71	**
5	Purple Gem	52.30	86.05	-8.48	o
6	Colour Spectable	84.13	138.42	23.35	***
7	Princess	33.63	55.33	-27.15	ooo
8	Josephine	64.54	106.19	3.76	n.s.
Control	Average of the experience	60.78	100.00	-	-

LSD 5% = 7.62    LSD 1% = 12.71    LSD 0.1% = 20.01

Compared to the control of this character, the average of the experience (60.78 cm), very significant positive differences are observed in the 'Colour Spectable' cultivar and distinctly significant positive differences in the 'Veritable'. Three of the eight cultivars analyzed ('Tsuki Yori No', 'Procyon' and 'Josephine') do not show significant differences compared to the average of the experience.

At the opposite pole, very significantly negative differences of this character are registered in the 'Princess' cultivar, while the 'Purple Gem' cultivar registers significantly negative differences.

As a general opinion, we can say that the varieties with the highest average flower stem length are representative and recommended for use as cut flowers, and those with the lowest average are recommended for use in green spaces.

**The number of flowers /plant**

One of the most important characteristics that recommend the cultivation of flowers is the number of inflorescences that appear throughout the vegetation period. In Table 4, it can be seen that the cultivar 'Colour Spectable' has the highest average number of flowers per plant (53.2), followed by 'Procyon' with 44.9 flowers per plant, while the cultivars 'Princess' (34.6), and 'Veritable' (35.7) have the lowest number of flowers.

**Table 4.** The number of flowers /plant

No. var.	Cultivar	Average flowers/plant no.	Relative value (%)	± d (no.)	Significance of differences
1	Record	40.3	100.34	-0.9	n.s.
2	Tsuki Yori No	42.8	103.88	1.6	n.s.
3	Procyon	44.9	108.98	3.7	*
4	Veritable	35.7	86.65	-5.5	oo
5	Purple Gem	39.0	94.66	-2.2	n.s.
6	Colour Spectable	53.2	129.13	12.0	***
7	Princess	34.6	83.98	-6.6	ooo
8	Josephine	38.9	94.42	-2.3	n.s.
Control	Average of the experience	41.2	100.00	-	-

LSD 5% = 3.5 LSD1% = 4.6 LSD 0.1% = 6.1

The average of the experience for the analyzed characteristic among the eight analyzed cultivars had the value of 41.2 flowers/plant.

Following the analysis of the results, it is observed that compared to the average of the experiment considered as a control, the 'Colour Spectable' show a real and very significant positive difference, respectively positively significant ('Procyon') regarding the number of flowers per plant, while at the opposite pole the cultivar 'Princess' shows a very significant negative difference, and 'Veritable' shows a distinctly significant negative difference, compared to the average experience of the studied character.

The comparison made allows us to formulate a general conclusion, the 'Colour Spectable' and 'Procyon' cultivars had the best behavior in the experimental conditions regarding the number of flowers and there is a chance of achieving some successful crops, at the opposite pole finding the cultivars 'Princess' and 'Veritable'.

**The diameter of the flowers**

The diameter of the inflorescences is of great importance from a decorative point of view, being a character that influences the choice of flowers for use as cut flowers or in landscaping projects. According to this experience we can observe (Table 5) the largest diameter in 'Colour Spectable' (24.9 cm), 'Tsuki Yori No' (18.8 cm) and 'Veritable' (17.2 cm), and the smallest in the cultivars 'Princess' (9.4 cm), 'Record' (10.5 cm), 'Procyon' (10.9 cm) and 'Purple Gem' (11.6 cm).

**Table 5.** The diameter of the flowers

No. var.	Cultivar	Average diameter flower (cm)	Relative value (%)	± d (cm)	Significance of differences
1	Record	10.5	71.57	-4.17	ooo
2	Tsuki Yori No	18.8	128.15	4.13	***
3	Procyon	10.9	74.30	-3.77	ooo
4	Veritable	17.2	117.25	2.53	***
5	Purple Gem	11.6	79.07	-3.07	ooo
6	Colour Spectable	24.9	169.73	10.23	***
7	Princess	9.40	64.08	-5.27	ooo
8	Josephine	14.1	96.11	-0.57	oo
Control	Average of the experience	14.67	100.00	-	-

*LSD 5% = 0.4 LSD 1% = 0.5 LSD 0.1% = 0.7*

The average of the experience for the analyzed characteristic among the eight analyzed cultivars had the value of 14.67 cm. The diameter of the dahlia flowers taken in the study is presented in two groups following the data analysis, thus in the cultivars with diameter higher than experience average ('Tsuki Yori No', 'Veritable', and 'Colour Spectable'), and the cultivars with diameter lower than experience average ('Record', 'Procyon', 'Purple Gem' and 'Princess').

#### ***The number of ligules/flower***

Analyzing the Table 6, with the exception of the 'Tsuki Yori No' cv, which has an average of 150.2 ligules per flower, being in the position of higher, and the 'Purple Gem' cultivar, was in the lowest position, with an average of 93.7 ligules per flower.

**Table 6.** The number of ligules/flower

No. var.	Cultivar	Average ligules no.	Relative value (%)	± d (no.)	Significance of differences
1	Record	115.6	97.43	-3.05	n.s.
2	Tsuki Yori No	150.2	126.59	31.5	***
3	Procyon	110.3	92.96	-8.35	n.s.
4	Veritable	124.5	104.93	5.85	n.s.
5	Purple Gem	93.7	78.97	-24.95	oo
6	Colour Spectable	115.1	97.01	-3.55	n.s.
7	Princess	139.0	117.15	20.35	*
8	Josephine	100.8	85.00	-17.85	n.s.
Control	Average of the experience	118.65	100.00	-	-

*LSD 5% = 19.2 LSD 1% = 23.1 LSD 0.1% = 29.7*

According to the results of the statistical analysis, most cultivars do not show a significant difference compared to the average of the experience taken as a control, these cultivars being: 'Record', 'Procyon', 'Veritable', 'Colour Spectable' and 'Josephine'. A very significant positive difference regarding the analyzed character is highlighted in 'Tsuki Yori No', and significant negative differences are presented by the cultivar 'Purple Gem' where the

number of ligules presents distinctly significant negative differences compared to the average of the experience (control). Consequently, we can say that all cultivars can be recommended from the point of view of the number of ligules, except for the 'Purple Gem'. The evaluation of morho-decorative characteristics was also carried out by other researchers in other genera, such as: *Hemerocallis* (Bahrim *et al.*, 2019), *Gladiolus* (Horț *et al.*, 2014), *Gerbera* (Drăghici *et al.*, 2020), *Pelargonium* (Moldovan *et al.*, 2021), which confirm a good adaptability at the crops conditions, fact that supports the recommendation of their extension in the culture.

### Studies on the content of soluble dry matter and chlorophyll at *Dahlia*

#### *The content of soluble dry matter in tuberous roots*

The study of the present experiment focused on the determination of the content of soluble dry matter in the tuberous roots of *Dahlia* at harvest.

**Table 7.** The average content of soluble dry matter (%) in the tuberous roots of *Dahlia*

No. var.	Planting material	Cultivar	Average soluble dry content (%)*
V <sub>1</sub>	Tuberous roots	Record	24.81AB
V <sub>2</sub>		Tsuki Yori No	24.37 AB
V <sub>3</sub>		Procyon	15.13 DE
V <sub>4</sub>		Veritable	19.53 ABCD
V <sub>5</sub>		Purple Gem	15.82 CDE
V <sub>6</sub>		Colour Spectable	20.23 ABC
V <sub>7</sub>		Princess	11.63 E
V <sub>8</sub>		Josephine	22.57ABC
			SD 5% = 6.57-7.74

\*The difference between any two values followed by at least one common letter is insignificant

Analyzing Table 7, it can be seen in the case of cultivars 'Princess', 'Procyon' and 'Purple Gem' that the average value of soluble dry matter in the tuberous roots was lower. Significant higher differences are recorded between the V<sub>1</sub> (24.81 %), V<sub>2</sub> (24.37 %) and the variants V<sub>7</sub> (11.63 %), V<sub>3</sub> (15.13 %) variants which are different in value.

The variants V<sub>7</sub> - 'Princess' (11.63 %), V<sub>3</sub> - 'Procyon' (15.13) and V<sub>4</sub> - 'Purple Gem' (15.82 %) differ significantly less than the other variants. The results obtained are similar to those obtained by Ciobanu *et al.* (2016) which identifying a greater amount of dry matter in dahlia variants whose tuberous roots were unforced before planting 'Kennemerland' (24.27%) and 'Tsuki Yori No' (24.80 %). Baldini *et al.* (2000) found a wide variability in the genotypes of *Helianthus tuberosus* studied, obtaining an average value of 22.9 % for soluble dry matter.

#### *Chlorophyll content of leaves*

The amount of chlorophyll in the leaves is important in the photosynthesis process of plants, having two essential actions: light absorption and the transformation of light energy into chemical energy. Following the research (Table 8), it can be seen that the cultivar 'Tsuki Yori No' had the highest chlorophyll content, with a value of 524.89  $\mu\text{mol}/\text{m}^2$ , and the lowest value was determined in the 'Josephine', 375.23  $\mu\text{mol}/\text{m}^2$ .



**Table 8.** Chlorophyll content of *Dahlia* leaves

No. var.	Cultivar	Average chlorophyll ( $\mu\text{mol}/\text{m}^2$ )	Relative value (%)	$\pm d$ ( $\mu\text{mol}/\text{m}^2$ )	Significance of differences
1	Record	400.87	87.66	-57.30	o
2	Tsuki Yori No	524.89	114.78	67.59	*
3	Procyon	494.22	108.074	36.92	n.s.
4	Veritable	439.27	96.06	-18.03	n.s.
5	Purple Gem	497.06	108.69	39.76	n.s.
6	Colour Spectable	518.55	113.39	61.25	*
7	Princess	408.31	89.29	-48.99	n.s.
8	Josephine	375.23	82.05	-82.30	oo
Control	Average of the experience	457.30	100.00	-	-

LSD 5% = 56.17 LSD 1% = 72.92 LSD 0.1% = 90.95

The statistical analysis allows us to observe the fact that four of the eight cultivars show non-significant differences compared to the control ( $457.30 \mu\text{mol}/\text{m}^2$ ), and the cultivars 'Tsuki Yori No' and 'Colour Spectable' show significant positive differences compared to the control, while 'Record' shows significant negative differences, and 'Josephine' distinctly significantly negative compared to the control in terms of chlorophyll content.

## CONCLUSIONS

Following the observations and determinations made, it is found that the cultivars of *Dahlia* 'Colour Spectable', 'Tsuki Yori No' and 'Veritable' stood out for the large number of flowers and their diameter, great vigor and well branched.

The cultivars 'Record', 'Tsuki Yori No', 'Josephine' and 'Colour Spectable' stood out in terms of the highest amount of soluble dry matter in the tuberous roots and the chlorophyll content showed significant differences in the cultivars 'Tsuki' Yori No' and 'Colour Spectable'.

We conclude that the dahlia is a crop with great potential in Romania floriculture thus, it is evident the need to improve the Romanian assortment with new cultivars which adapted to the ecological conditions, and production demands. Expanding the number of types, cultivars, colors and sizes offers a strong possibility of increasing production, and its quality.

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